Docket No. 61003 (70820)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

APPELLANT:	Y. Kii	CONF. NO.:	3397
U.S. SERIAL NO.:	10/797,743	EXAMINER:	J. Repko
FILED:	March 9, 2004	GROUP:	2628
FOR:	METHOD AND APPARATUS FOR HIGH-SPEED SHADOWING USING SHADOW VOLUMES		

Mail Stop Appeal Brief—Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

BRIEF ON APPEAL

Sir:

This is an appeal from the final rejection of claims 1-11, as included in the Final Office Action mailed by the U.S. Patent and Trademark Office on September 6, 2007.

BRIEF ON APPEAL FEE

Authorization to charge Deposit Account No. 04-1105 for $510.00 for the appeal brief fee is provided herewith. However, if for any reason a fee is required, a fee paid is inadequate or credit is owed for any excess fee paid, the Commissioner is hereby authorized and requested to charge Deposit Account No. **04-1105**.

REAL PARTY IN INTEREST

The real party in interest is Sharp Kabushiki Kaisha. The assignment of the inventor to this corporation was recorded on March 9, 2004 at Reel 015087, Frame 0922.

RELATED APPEALS AND INTERFERENCES

There are no related appeals or interferences known to Appellant, Appellant's legal representative, or the assignee which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

STATUS OF CLAIMS

Claims 1-11 stand finally rejected. Claims 1-11 are appealed.

STATUS OF AMENDMENTS

No amendments have been filed after issuance of the Final Office Action.

A Pre-Appeal Brief Request for Review was filed on December 6, 2007. A Notice of Panel Decision from Pre-Appeal Brief Review issued on February 1, 2008, indicating that the application remains under appeal.

A clean set of the claims on appeal is set forth in the Claims Appendix hereto.

SUMMARY OF CLAIMED SUBJECT MATTER

Independent claims 1, 4, and 9 are pending in the application.

Independent claim 1 is directed to a "graphic processing apparatus having a Z-buffer memory storing a Z value representing a depth of a display object when seen from a visual point per pixel and a pixel memory storing color data on each pixel for creating an image of a shadowed three-dimensional object having a shadow produced by obstructing a ray of light from a light source by the three-dimensional object" (preamble of claim 1; see, e.g., paragraph 0020 of the specification).

Independent claim 1 recites a "visual-point coordinate conversion processing section" for receiving graphic data of normal polygons constituting each object and shadow polygons forming a shadow volume, converting the graphic data to visual point coordinates (x, y) and depth values (z), and outputting these values (x, y, z) "in a state of being sorted into those of front-facing shadow polygons that face front, those of back-facing shadow polygons that face back when seen from the visual point, and those of the normal polygons" (see, e.g., paragraphs 0061-0062 of the specification).

As recited in independent claim 1, the graphic data is converted to visual-point coordinates including x-coordinates and y-coordinates and depth values for normal polygons and

shadow polygons (see, e.g., paragraphs 0078 to 0089 of the specification). As such, at least the visual-point coordinates and depth values can be outputted in a state of being sorted between front-facing shadow polygons that face front and back-facing shadow polygons that face back.

Independent claim 1 further recites a "hidden surface removal and shadowing processing section for obtaining a coordinate region that is positioned behind the front-facing shadow polygons and in front of the back-facing shadow polygons when seen from the visual point based on the visual-point coordinates, the depth values and the Z-buffer memory" after hidden surface removal is performed on the normal polygons by a Z-buffer method, and color data in the pixel memory is updated (see, e.g., paragraphs 0064-0065, 0071-0080, and 0084-0086).

Independent claim 4 is directed to a "graphic processing apparatus having a Z-buffer memory storing a Z value representing a depth of a display object when seen from a visual point per pixel and a pixel memory storing color data on each pixel for creating an image of a shadowed three-dimensional object having shadows produced by obstructing a ray of light from a light source by the three-dimensional object" (preamble of claim 4; see, e.g., paragraph 0027 of the specification).

Independent claim 4 recites a "normal polygon conversion section" for receiving graphic data of normal polygons constituting each object, converting the graphic data to visual-point coordinates (x, y) and depth values (z), as described, for example, in paragraph 0062 of the specification.

Independent claim 4 also recites a "shadow polygon conversion section" for receiving graphic data of shadow polygons forming a shadow volume, converting the graphic data to visual-point coordinates (x, y) and depth values (z), and outputting these values (x, y, z) "in a state of being sorted into those of front-facing shadow polygons that face front when seen from a visual point and those of back-facing shadow polygons that face back when seen from the visual point" (see, e.g., paragraph 0062 of the specification).

As recited in independent claim 4, the graphic data is converted to visual-point coordinates including x-coordinates and y-coordinates and depth values for normal polygons and shadow polygons (see, e.g., paragraphs 0078 to 0089 of the specification). As such, at least the

visual-point coordinates and depth values can be outputted in a state of being sorted between front-facing shadow polygons that face front and back-facing shadow polygons that face back.

Further, as recited in independent claim 4, a "normal polygon processing section" performs hidden surface removal processing by a Z-buffer method on the normal polygons based on the visual-point coordinates and the depth values of the normal polygons, and updates color data and a Z value of each pixel in the pixel memory and the Z-buffer memory (see, e.g., paragraphs 0072-0073 of the specification).

Further, as recited in independent claim 4, a "back-facing shadow polygon processing section" obtains a coordinate region positioned in front of the back-facing shadow polygons (see, e.g., paragraphs 0077-0080 of the specification).

Further, as recited in independent claim 4, a "shadow flag memory" stores a flag value representing a visual-point coordinate positioned in front of the back-facing shadow polygons (see, e.g., paragraph 0063 of the specification).

Further, as recited in independent claim 4, a "front-facing shadow polygon processing section" obtains a coordinate region positioned behind the front-facing shadow polygons and in front of the back-facing shadow polygons after hidden surface removal processing is performed (see, e.g., paragraphs 0084-0086 of the specification).

Independent claim 9 is directed to a "graphic processing method using a Z-buffer memory storing a Z value representing a depth of a display object when seen from a visual point per pixel and a pixel memory storing color data on each pixel for creating an image of a shadowed three-dimensional object having shadows produced by obstructing a ray of light from a light source by the three-dimensional object" (preamble of claim 9; see, e.g., paragraph 0038 of the specification).

Independent claim 9 recites a step of "converting graphic data on normal polygons" to visual-point coordinates (x, y) and depth values (z), as described, for example, in paragraph 0062 of the specification.

Independent claim 9 also recites a step of "converting graphic data on shadow polygons" to visual-point coordinates (x, y) and depth values (z), and sorting these values (x, y, z) "into

those of front-facing shadow polygons that face front when seen from the visual point and those of back-facing shadow polygons that face back when seen from the visual point" (see, e.g., paragraph 0062 of the specification).

As recited in independent claim 9, the graphic data is converted to visual-point coordinates including x-coordinates and y-coordinates and depth values for normal polygons and shadow polygons (see, e.g., paragraphs 0078 to 0089 of the specification). As such, at least the visual-point coordinates and depth values can be outputted in a state of being sorted between front-facing shadow polygons that face front and back-facing shadow polygons that face back.

Further, independent claim 9 recites a step of performing hidden surface removal processing by a Z-buffer method on the normal polygons based on the visual-point coordinates and the depth values of the normal polygons, and updating color data and a Z value of each pixel in the pixel memory and the Z-buffer memory (see, e.g., paragraphs 0072-0073 of the specification).

Further, independent claim 9 recites a step of obtaining a coordinate region positioned in front of the back-facing shadow polygons (see, e.g., paragraphs 0077-0080 of the specification).

Further, independent claim 9 recites a step of obtaining a coordinate region positioned behind the front-facing shadow polygons and in front of the back-facing shadow polygons after hidden surface removal processing is performed (see, e.g., paragraphs 0084-0086 of the specification).

Further, independent claim 9 recites a step of updating color data on pixels in the pixel memory corresponding to the coordinate regions positioned behind the front-facing shadow polygons and in front of the back-facing shadow polygons (see, e.g., paragraph 0063 of the specification).

GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

Whether claims 1, 3, 4, 6, and 9-11 are anticipated under 35 USC §102(e) by U.S. Patent 6,744,430 to Shimizu (hereinafter "Shimizu").

Whether claims 2 and 5 are unpatentable under 35 USC §103(a) over Shimizu in view of U.S. Patent 5,517,603 to Kelley et al. (hereinafter "Kelley").

Whether claims 7 and 8 are unpatentable under 35 USC §103(a) over Shimizu in view of U.S. Patent 6,402,615 to Takeuchi (hereinafter "Takeuchi").

ARGUMENT

The arguments contained herein pertain to the grounds of rejection listed above, i.e., that claims 1, 3, 4, 6, and 9-11 are not anticipated by Shimizu, and claims 2, 5, 7, and 8 are not obvious over Shimizu in view of Kelley or Takeuchi. The following subheadings I to III address shortcomings in these grounds of rejection. In summary, independent claims 1, 4, and 9 are patentable over the Shimizu reference, and the final rejection should be vacated. Moreover, the respective dependent claims are patentable over Shimizu, whether taken alone or in view of Kelley or Takeuchi.

I. There is no teaching or suggestion in Shimizu of a graphic processing apparatus or method in which a hidden surface removal process is performed for "obtaining a coordinate region that is positioned behind the front-facing shadow polygons and in front of the back-facing shadow polygons," as recited in independent claims 1, 4, and 9.

On page 4 of the Final Office Action, the following sections of Shimizu were cited allegedly for teaching the claimed "hidden surface removal and shadowing processing section": column 18, lines 49-51 and column 21, lines 25-27.

Column 18, lines 49-51 of Shimizu states: "The region buffers 220-1 and 220-n store information on whether something is inside or outside a volume (region), pixel by pixel."

Column 21, lines 25-27 of Shimizu states: "The sort preprocessor (Z buffer) 110 outputs the polygon ID positioned foremost for each pixel, layer by layer."

In other words, the above sections of Shimizu merely describe that the pixels of an object can be either "inside or outside" a given volume or region on a pixel-by-pixel basis, and the polygon ID "positioned foremost" is outputted for each pixel, layer by layer.

Therefore, there is simply no teaching or suggestion in Shimizu of performing hidden surface removal and shadow processing in order to obtain a coordinate region "positioned behind the front-facing shadow polygons and in front of the back-facing shadow polygons," as recited in independent claims 1, 4, and 9.

II. The "layer by layer" processing disclosed in Shimizu is not equivalent to the Appellant's claimed coordinate region "positioned behind the front-facing shadow polygons and in front of the back-facing shadow polygons," as recited in independent claims 1, 4, and 9.

On page 13, last paragraph to page 14, first paragraph of the Final Office Action, the Examiner alleged that the "layer by layer" processing of Shimizu corresponds to the Appellant's claimed coordinate region.

However, independent claims 1, 4, and 9 do not require "layer by layer" processing, and the "layer by layer" approach to outputting polygon IDs, as disclosed in Shimizu, does not teach or suggest the Appellant's claimed coordinate region "positioned behind the front-facing shadow polygons and in front of the back-facing shadow polygons."

There is simply no teaching or suggestion in Shimizu of the Appellant's claimed apparatus or method in which hidden surface removal and shadow processing are performed in order to obtain a coordinate region "positioned behind the front-facing shadow polygons and in front of the back-facing shadow polygons," as recited in independent claims 1, 4, and 9.

III. In the Final Office Action, the Examiner engaged in hindsight reasoning by reading one or more limitations of the Appellant's claimed invention into the Shimizu reference, and has not identified any teaching or suggestion of the Appellant's claimed coordinate region "positioned behind the front-facing shadow polygons and in front of the back-facing shadow polygons."

On page 14, last paragraph of the Office Action of 09/06/2007, the Examiner alleged that: "In the Shimizu reference, if a polygon is inside a volume, then it is behind the front facing shadow polygons and in front of the back facing shadow polygons relative to a viewpoint, and vice versa."

There is simply no teaching or suggestion in Shimizu to support the above allegation. In particular, the Shimizu reference does not separate polygons into "front facing shadow polygons" and "back facing shadow polygons" *as claimed.*

In Shimizu, column 21, lines 25-27 merely teaches that the polygon IDs positioned foremost are outputted for each pixel "layer by layer."

For at least the reasons discussed above, the Shimizu reference does not anticipate or otherwise render obvious the Appellant's claimed invention. Therefore, independent claims 1, 4, and 9 and their respective dependent claims are patentable over Shimizu.

Appellant submits that all of the claims under final rejection are in condition for allowance and should be allowed, and that the Final Office Action should be vacated.

Respectfully submitted,

/Steven M. Jensen/

Date: March 3, 2008

Steven M. Jensen
(Reg. No. 42,693)
Edwards Angell Palmer & Dodge
P.O. Box 55874
Boston, MA 02205

Phone: (617) 239-0100

Customer No. 21874

CLAIMS APPENDIX

Claim 1 (previously presented): A graphic processing apparatus having a Z-buffer memory storing a Z value representing a depth of a display object when seen from a visual point per pixel and a pixel memory storing color data on each pixel for creating an image of a shadowed three-dimensional object having a shadow produced by obstructing a ray of light from a light source by the three-dimensional object, comprising:

a visual-point coordinate conversion processing section for upon input of graphic data on normal polygons constituting each object including the three-dimensional object and on shadow polygons constituting a shadow volume that defines a shadow space produced by obstructing the ray of light from the light source by the three-dimensional object, converting the graphic data to visual-point coordinates including x-coordinates and y-coordinates and depth values, and outputting the obtained visual-point coordinates and depth values in a state of being sorted into those of front-facing shadow polygons that face front, those of back-facing shadow polygons that face back when seen from the visual point, and those of the normal polygons; and

a hidden surface removal and shadowing processing section for obtaining a coordinate region that is positioned behind the front-facing shadow polygons and in front of the back-facing shadow polygons when seen from the visual point based on the visual-point coordinates, the depth values and the Z-buffer memory after hidden surface removal processing by Z-buffer method is performed on the normal polygons, and updating color data on pixels in the pixel memory corresponding to the obtained coordinate region to shadow color data.

Claim 2 (original): The graphic processing apparatus as defined in claim 1, wherein

the Z-buffer memory and the pixel memory have a capacity for one line in one display screen, and

the visual-point coordinate conversion processing section and the hidden surface removal and shadowing processing section process per line.

Claim 3 (original): The graphic processing apparatus as defined in claim 1, wherein

if a plurality of the shadow volumes are present, the hidden surface removal and shadowing processing section performs processing concerning the shadow polygons per shadow volume.

Claim 4 (previously presented): A graphic processing apparatus having a Z-buffer memory storing a Z value representing a depth of a display object when seen from a visual point per pixel and a pixel memory storing color data on each pixel for creating an image of a shadowed three-dimensional object having shadows produced by obstructing a ray of light from a light source by the three-dimensional object, comprising:

a normal polygon conversion section for upon input of graphic data on normal polygons constituting each object including the three-dimensional object, converting the graphic data to visual-point coordinates including x-coordinates and y-coordinates and depth values;

a shadow polygon conversion section for upon input of graphic data on shadow polygons constituting a shadow volume that defines a shadow space produced by obstructing the ray of

light from the light source by the three-dimensional object, converting the graphic data to visual-point coordinates including x-coordinates and y-coordinates and depth values, and outputting the visual-point coordinates and the depth values in a state of being sorted into those of front-facing shadow polygons that face front when seen from a visual point and those of back-facing shadow polygons that face back when seen from the visual point;

a normal polygon processing section for performing hidden surface removal processing by Z-buffer method on the normal polygons based on the visual-point coordinates and the depth values of the normal polygons and updating color data and a Z value of each pixel in the pixel memory and the Z-buffer memory based on the processing result;

a back-facing shadow polygon processing section for obtaining a coordinate region positioned in front of the back-facing shadow polygons when seen from the visual point based on the visual-point coordinates and the depth values of the back-facing shadow polygons and on the Z values after the hidden surface removal processing is performed;

a shadow flag memory for storing a flag value representing a visual-point coordinate positioned in front of the back-facing shadow polygons; and

a front-facing shadow polygon processing section for obtaining a coordinate region positioned behind the front-facing shadow polygons and in front of the back-facing shadow polygons when seen from the visual point based on the visual-point coordinates and the depth values of the front-facing shadow polygons and on the Z values after the hidden surface removal processing is performed and on the flag value, and for updating color data on pixels in the pixel memory corresponding to the obtained coordinate region to shadow color data.

Claim 5 (original): The graphic processing apparatus as defined in claim 4, wherein

the Z-buffer memory, the pixel memory, and the shadow flag memory have a capacity for one line in one display screen, and

the normal polygon conversion section, the shadow polygon conversion section, the normal polygon processing section, the back-facing shadow polygon processing section, and the front-facing shadow polygon processing section process per line.

Claim 6 (original): The graphic processing apparatus as defined in claim 4, wherein

if a plurality of the shadow volumes are present, the back-facing shadow polygon processing section and the front-facing shadow polygon processing section perform processing concerning the shadow polygons per shadow volume.

Claim 7 (original): The graphic processing apparatus as defined in claim 4, wherein

the normal polygon conversion section, the shadow polygon conversion section, the normal polygon processing section, the back-facing shadow polygon processing section, and the front-facing shadow polygon processing section are included in a portable device.

Claim 8 (original): The graphic processing apparatus as defined in claim 7, wherein

the portable device is connectable to a communication network, and the graphic data is obtained through communications via the communication network.

Claim 9 (previously presented): A graphic processing method using a Z-buffer memory storing a Z value representing a depth of a display object when seen from a visual point per pixel and a pixel memory storing color data on each pixel for creating an image of a shadowed three-dimensional object having shadows produced by obstructing a ray of light from a light source by the three-dimensional object, comprising:

converting graphic data on normal polygons constituting each object including the three-dimensional object to visual-point coordinates including x-coordinates and y-coordinates and depth values;

converting graphic data on shadow polygons constituting a shadow volume that defines a shadow space produced by obstructing the ray of light from the light source by the three-dimensional object to visual-point coordinates including x-coordinates and y-coordinates and depth values, and sorting the visual-point coordinates and the depth values into those of front-facing shadow polygons that face front when seen from the visual point and those of back-facing shadow polygons that face back when seen from the visual point;

performing hidden surface removal processing by Z-buffer method on the normal polygons based on the visual-point coordinates and the depth values of the normal polygons and updating color data and a Z value of each pixel in the pixel memory and the Z-buffer memory based on the processing result;

obtaining a coordinate region positioned in front of the back-facing shadow polygons when seen from the visual point based on the visual-point coordinates and the depth values of the

back-facing shadow polygons and the Z values after the hidden surface removal processing is performed;

obtaining a coordinate region positioned behind the front-facing shadow polygons when seen from the visual point based on the visual-point coordinates and the depth values of the front-facing shadow polygons and the Z values after the hidden surface removal processing is performed; and

updating color data on pixels in the pixel memory corresponding to a coordinate region positioned behind the front-facing shadow polygons and in front of the back-facing shadow polygons when seen from the visual point to shadow color data.

Claim 10 (previously presented): The graphic processing apparatus as defined in claim 4 running a graphic processing program causing a computer to function as the normal polygon conversion section, the shadow polygon conversion section, the normal polygon processing section, the back-facing shadow polygon processing section, and the front-facing shadow polygon processing section.

Claim 11 (original): A program storage medium allowing computer to read, characterized in that the graphic processing program as defined in claim 10 is stored.

EVIDENCE APPENDIX

Attachment A	Copy of U.S. Patent No. 6,744,430 to Shimizu, as relied on by the Examiner in the Final Office Action.
Attachment B	Copy of U.S. Patent No. 5,517,603 to Kelley et al., as relied on by the Examiner in the Final Office Action.
Attachment C	Copy of U.S. Patent No. 6,402,615 to Takeuchi, as relied on by the Examiner in the Final Office Action.

RELATED PROCEEDINGS APPENDIX

None.